ARL-TR-7562 ● DEC 2015

US Army Research Laboratory

US Army Research Laboratory Joint Interagency Field Experimentation 15-2 Final Report

by Elizabeth K Bowman and Randal J Zimmerman

NOTICES

Disclaimers

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

Citation of manufacturer's or trade names does not constitute an official endorsement or approval of the use thereof.

Destroy this report when it is no longer needed. Do not return it to the originator.

ARL-TR-7562 ● DEC 2015

US Army Research Laboratory

US Army Research Laboratory Joint Interagency Field Experimentation 15-2 Final Report

by Elizabeth K Bowman
Computational and Information Sciences Directorate, ARL

Randal J Zimmerman
Zimmerman Consulting Group, LLC, Leavenworth, KS

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED (From - To)
December 2015	Final	1 October 2014–30 September 2015

4. TITLE AND SUBTITLE
Army Research Laboratory Joint Interagency Field Experimentation 15-2 Final Report

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Elizabeth K Bowman and Randal J Zimmerman

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
US Army Research Laboratory
ATTN: RDRL-CII-T
Aberdeen Proving Ground, MD 21005-5067

8. PERFORMING ORGANIZATION REPORT NUMBER
ARL-TR-7562

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT
The US Army Research Laboratory (ARL) Data to Decisions team participated in the Naval Postgraduate School (NPS)–sponsored Joint Interagency Field Experimentation (JIFX) 15-2, 9–13 February 2015, at Alameda Island, California. Advanced text analytics capabilities were demonstrated in a logically coherent workflow pipeline that supported the military observe, orient, decide, and act loop and allowed cross-cueing of a wide-area motion imagery sensor. The aggregated findings of these text processing capabilities allowed the targeted use of a persistent imagery sensor for rapid detection of mission-critical events. The creation of a very large text database from open source data provides a relevant and unclassified foundation for continued development of text-processing capabilities. The ground truth features of the data set provide a valuable contribution to the test and evaluation of emerging technologies. This demonstration established near-term advanced capabilities for machine processing and text-imagery cueing. The NPS JIFX demonstration venue was shown to be valuable for emerging technologies at midrange technology readiness levels. The access to Combatant Command science and technology officers supports communication between scientists and military advisors, which serves to enhance the military relevance of new capabilities developed by university and industry technologists not familiar with military tactics, techniques, and procedures.

15. SUBJECT TERMS
data to decisions, decision making, text analytics, wide-area motion imagery, OODA Loop

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER (Include area code)
Unclassified	Unclassified	Unclassified	UU	24	Elizabeth K Bowman 410-278-5924

Contents

List of Figures

Executive Summary

The US Army Research Laboratory (ARL) Data to Decisions team participated in the Naval Postgraduate School–sponsored Joint Interagency Field Experimentation (JIFX) 15-2, 9–13 February 2015, at Alameda Island, California. The ARL team, composed of government and contractor scientists, was joined by teams of engineers and computer scientists from the US Air Force Research Laboratory Wide-Area Motion Imagery (WAMI) directorate and the Michigan Institute of Technology–Lincoln Laboratory to demonstrate how the use of text analytics and WAMI tools could be used to support operational planning and execution.

The JIFX setting offers government, private sector, academic, and nonprofit technologists an opportunity to engage directly with the Department of Defense, US federal civilian agencies, first responders, international partner nations, and companies in a semistructured learning environment that promotes collaboration and innovation while developing communities of interest and knowledge-sharing activities.

The JIFX environment is a unique opportunity for developers to engage with end-users in new or emerging concepts and solutions. By interacting directly with end users in a replicated operational environment, technologists are able to leverage the knowledge gained to improve or enhance their products, steer development to requirements, and reduce the time required to transition a technology, often saving in development time and dollars.

INTENTIONALLY LEFT BLANK.

1. Introduction

The Data-to-Decisions (D2D) research program in the area of text analytics is an Office of the Secretary of Defense (OSD), Office of the Assistant Secretary of Defense, Research and Engineering (ASD [R&E]) multiyear, funded, and directed program that is competitively awarded. The D2D program provides an opportunity to conduct objective assessments of analytics for rapid maturation to support understanding and develop improvements in mission effectiveness in time-constrained and data-intensive environments.

Military decision making requires supporting data from a variety of sources and in a wide range of formats to achieve success in its many missions. Text and language play an important part in many military missions by providing the key data required for understanding cultures, attitudes, events, and relationships that serve as the basis of many missions conducted around the world. With advances and increased use of Internet and mobile communications, text information is available in unprecedented amounts and formats, presenting a unique opportunity to gain understanding through text analytics. In the context of the D2D research program, text analytics refers to identification of a set of linguistic, statistical, and machine learning techniques that model and structure the information content of textual sources for exploratory data analysis, research, and investigation. Text analytics involves information retrieval, lexical analysis to study word frequency, data-mining techniques including link and association analysis, visualization, and predictive analytics.

The Department of Defense (DOD) recognizes the potential for text analytics to play a vital role in future capabilities that inform timely and accurate situational awareness in time-constrained, uncertain, and complex environments by developing capability in contextual understanding, event prediction, and machine translation and processing. The D2D program expects to achieve these capabilities through a spiral development process that begins with a scenario that exhibits several text analytics challenges described in the following section. This scenario supports an end-to-end demonstration prototype for each spiral to 1) analyze performance to identify critical science and technology needs, 2) provide data that can be distributed in support of science and technology development, 3) provide demonstrations of key technologies enabling assessment of technology maturity, 4) provide system solutions, system improvements, and alternative concepts of operations, and 5) develop a predictive capability for operations.

2. Wide-Area Motion Imagery

In recent years, the military has fielded several wide-area motion imagery (WAMI) sensor systems (e.g., Constant Hawk and Angel Fire) and is in the process of acquiring newer, more capable systems. These systems persistently monitor fixed geographic locations for long periods of time using electro-optic sensors. Some store their WAMI data onboard and download it at the end of each mission for postevent analysis and exploitation. Others provide operational support through real-time transfer of the WAMI data. Archived WAMI data are used mainly for postevent analysis or to perform network analysis of a facility of interest (as identified through other intelligence sources). In either case, analysts try to determine all the entities going to and from an event or facility of interest to ascertain the unique sources or destinations of those entities as a means to understand their participation in an event or their relationship in some network. Due to the manual techniques used, these analyses typically take many hours to many days to complete, and the end products are text reports with simple graphics. These reports are not machine readable (analysts produce shapefiles for only a tiny fraction of reports) and therefore preclude additional automated analysis and exploitation. Typically, real-time WAMI is used to give the battle commander better situational awareness. However, only the most simplistic use of the imagery is possible because of the time-consuming and manual nature of the available analysis tools.

As part of the overall persistent surveillance mission, the military services are expanding the deployment and development of airborne WAMI sensors. These sensors operate in predominantly urban settings, are capable of constantly monitoring many square kilometers for many hours, and generate terabytes of data per mission. Operationally, WAMI data are exploited for events of interest, both forensically and in real time. The real-time efforts, like Angel Fire, are limited to a small number of subframes and used primarily for force protection. Events of interest can include starting points and destinations of tracks and nodes for related entities within the persistent field of view. They can also include activity and event-based normalcy and anomaly detections such as unique driving behaviors occurring before the detonation of a suicidal vehicle. Other types of events can be used to discover or highlight “patterns-of-life” associated with a variety of network types, including social, political, regional, and economic or military networks.

The challenge is to identify potential threats based on the accumulation and correlation of multiple events and anomalies, and issue timely alerts with a minimal number of false alarms. WAMI data are having an increasing impact on operational outcomes, but current efforts to exploit these data are mostly manual and require

hours to days of painstaking analysis to produce results. The tedious nature of current exploitation capabilities limits the ability to fully utilize the available data. Consequently, critical battlefield questions go unanswered and timely threat cues are missed.

The primary information elements in WAMI data are entities in the context of roads, buildings, and other scene features. Exploitation of these entities yields tracks but in a complex urban environment, these tracks are severely fragmented due to occlusions, stops, and other factors. Within these localized events, algorithms that discover relationships and anomalies that are indicative of suspicious behavior, match previously learned threat activity, or match user-defined threat activity should also be incorporated. While the localized events may each occur over a small spatiotemporal window, the overall threat activity sequence may span a much larger spatiotemporal window.

3. Joint Interagency Field Experiment Program

The Joint Interagency Field Experimentation Program (JIFX) began in 2012 under the sponsorship of the OSD and the Department of Homeland (DHS) security. The JIFX setting offers government, private sector, academic, and nonprofit technologists an opportunity to engage directly with DHS, DOD, federal civilian agencies, and first responders in a semistructured learning environment promoting collaboration and innovation while fusing interactive community networking and knowledge-sharing activities.

The JIFX environment is a unique opportunity for developers to engage with end users in new or emerging concepts and solutions. By interacting directly with end users in a replicated operational environment, technologists are able to leverage the knowledge gained to improve or enhance their products, steer development to requirements, and reduce the time required to transition a technology, often saving millions of dollars in research and development.

Each quarter, a JIFX event uses different methods of interaction, all of which focus on end user input. This reflects and addresses the most complex challenges identified by those directly engaged in homeland defense and security.

Approximately 90 days before each JIFX event, the OSD and the Naval Postgraduate School (NPS) publish a Request for Information (RFI). The RFI seeks concept papers addressing specific technology challenges.

Select respondents are subsequently invited to participate in the JIFX experiments. The selection of respondents is based on the relationship of the technology to a particular class or level of capability that can be provided to the mission-sets in the RFI. Other considerations include technical maturity, relevance of or adaptability to missions, and relevance to current operational needs.

The JIFX success is enhancing the discovery of technologies and operation and performance capabilities.

Major objectives include the following:

- Explore the viability of new concepts as solutions for identified current and future capabilities
- Provide a venue for short-fused experimentation requirements
- Explore concepts of operation and human systems integration
- Explore technologies and solutions in support of whole-of-government, humanitarian and disaster relief, critical infrastructure/key resources protection; and interagency communications

4. OODA Loop as a Framework

The phrase OODA loop refers to the decision cycle *observe, orient, decide, and act* (OODA) developed by Major John Boyd, US Air Force. Boyd developed the concept to explain how to direct one's energies to defeat an adversary and survive. Boyd emphasized that "the loop" is actually a set of interacting loops that are to be kept in continuous operation during combat. He also indicated that the phase of the battle has an important bearing on the ideal allocation of one's energies.[1]

For JIFX, the team used the OODA loop construct (Fig. 1) to arrange and characterize how the various technology components might interact with each other and support the flow of information.

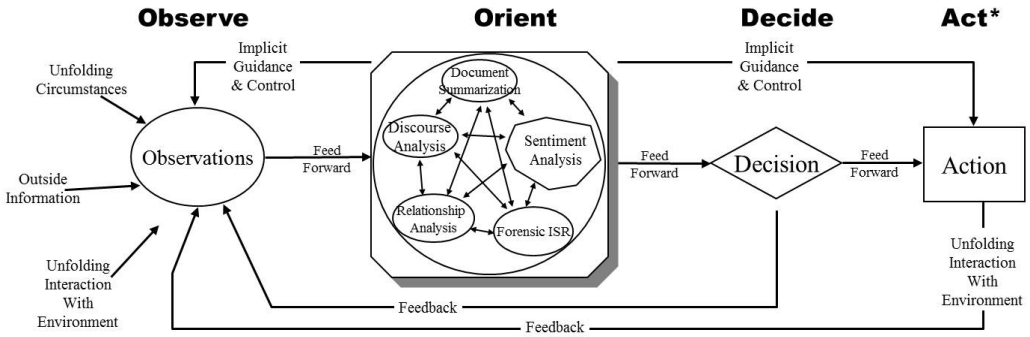

Fig. 1 Boyd OODA Loop (Adapted from Boyd JR. The essence of winning and losing. Unpublished briefing slides; 1996 Jan.)

The majority of the text analytic tools provided by the team focused on the observe and orient portions of the OODA loop model. Our interpretation of the observe phase was ingesting large data sets and processing the data using various tools/algorithms to provide some orientation on where issues might be occurring in a region of interest. The processed data resulted in a variety of document summaries, sentiment analysis of various groups, relationship analysis of the various participants and groups identified in the data, discourse analysis of what people and groups were saying, and finally, with the use of imagery analysis, forensic image analysis of specific areas was possible. The tools and their implementation into to a workflow are discussed in the next section.

5. Concept Demonstration

The participation of the combined government, industry and academia team led by the US Army Research Laboratory (ARL) was to demonstrate the concept of using text analytics to queue a sensor and vice versa. Our process (Fig. 2) started with a predictive analysis of the country of interest. In this case, the team focused on Nigeria and used open source data collection methods for compiling the necessary data for analysis. A workflow was developed by the team to demonstrate a cohesive flow of information and data products across the assembled technology capabilities. Figure 2 shows the capability spectrum mapped to the OODA loop. In green blocks are the text analytics performers with a high-level description of each capability. In blue blocks are the WAMI workstation and sensor inputs. In brown blocks are the scenario vignettes that were used to drive the information processing. Finally, in dark brown blocks, are the time lines used in the scenario. These time lines replicate actual information processing in military operations, with a combination of historical and real-time data inputs for the decision-making process.

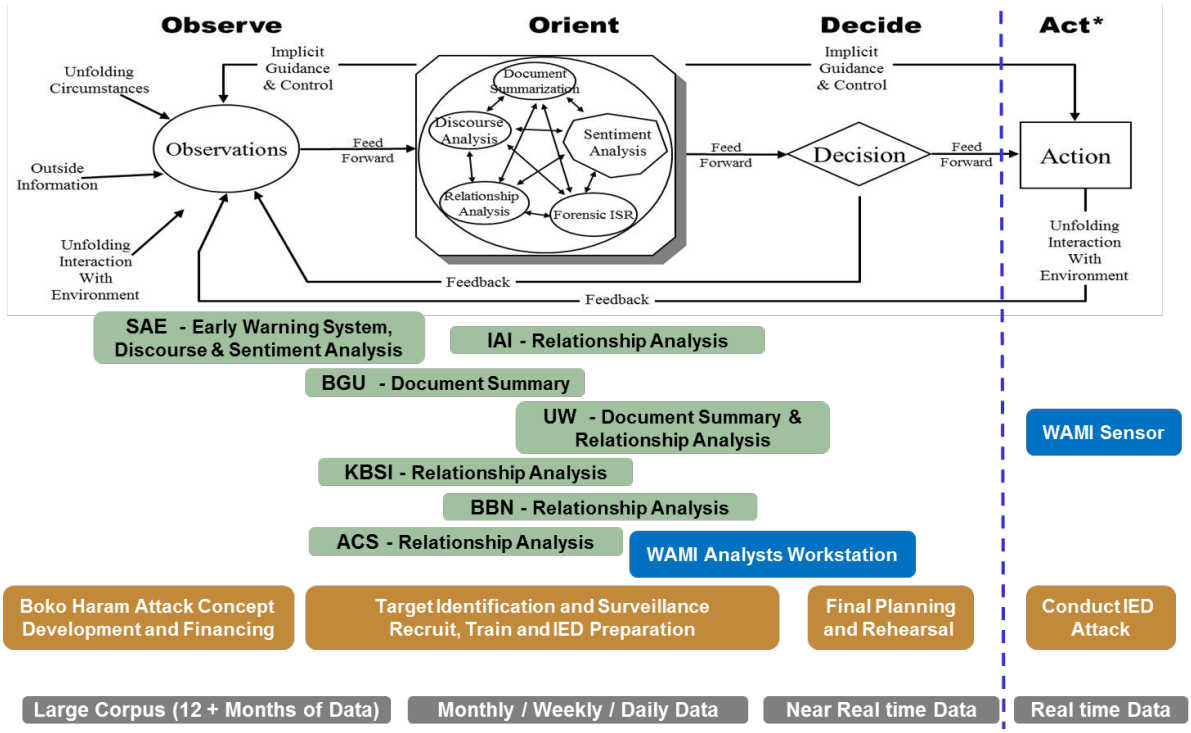

Fig. 2 Multisource data analytics framework

6. Scenario

For our team's participation in JIFX, we constructed a scenario focused on activities, places, groups, and people in Nigeria. The focus on Nigeria enabled the team to examine a variety of different data sources and groups of people. Because of the wealth of information and reports available in the public domain, we chose the terrorist group Boko Haram as the focus for our analysis effort. As part of the scenario, we developed a thread for an improvised explosive device attack against a foreign official. Our group objectives included the following:

- Predict the event, location, time
- Conduct sentiment analysis
- Conduct discourse analysis
- Identify potential victim
- Identify specific perpetrators
- Demonstrate the Text Analytics/WAMI provider capabilities and the complimentary nature of each tool
- Final goal: to provide actionable intelligence to a WAMI sensor operator

The scenario data set that was developed for this experiment included more than 40,000 documents from 5 different sources. The "ground truth" data set included more than 700 different tactical reports, intelligence reports, police reports, speeches, tweets, and various other documents. The ground truth data set identified relationships among groups of people and identified specific people of interest, planned meetings, and events. The ground truth was correlated to the open source data sets that were developed from reports on AllAfrica.com, and newspaper articles from *Nigeria Guardian News*, *Tribune News*, and *PM News Nigeria*. Figure 3 presents a graphic description of the data set contents. Each of the participating text analytics technologies used the data to provide insights into the planned terrorist activities, the various social groups, and their roles. In this sense, the scenario and data set provided an element of cohesion and integration across the individual technologies.

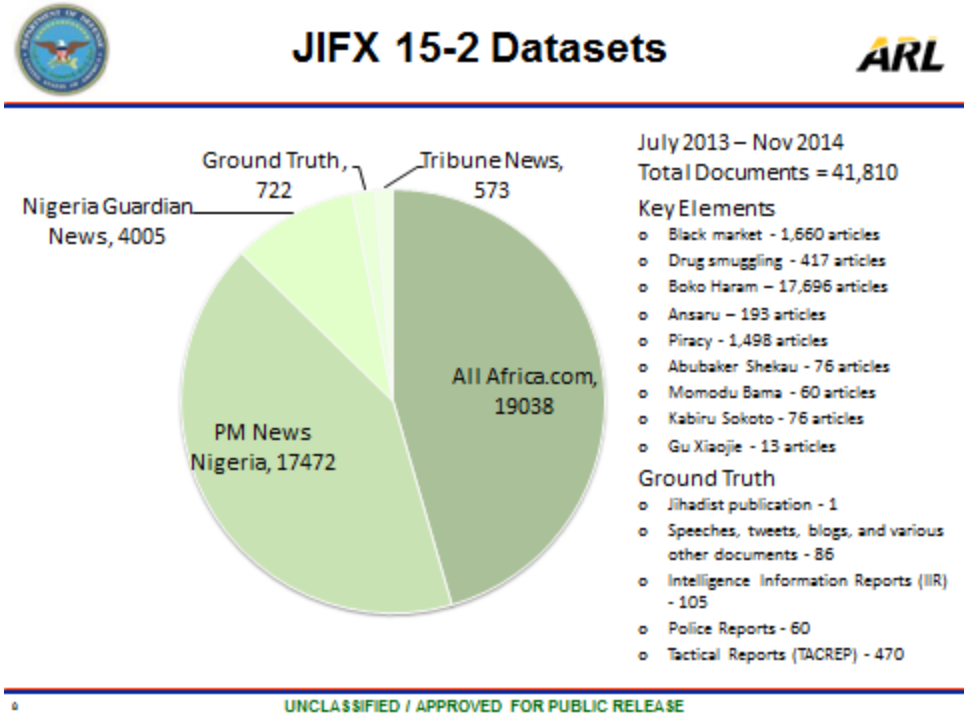

Fig. 3 Data set contents

7. Participant Experiment Summaries

This section includes a brief summary of the experiments and demonstrations that the joint ARL/US Air Force Research Laboratory (AFRL) team presented during JIFX 15-2.

7.1 US Army Research Laboratory

Topic: Multi-Source Data Analytics

JIFX Area of Focus: Intelligence, Surveillance, and Reconnaissance (ISR)

Summary: The Multi-source Data Analytics program demonstrated how imagery and text analytics can be used together for improved threat detection, contextual understanding, event prediction, and decision making. Advances in WAMI technology applications were recently demonstrated in Trident Spectre 14. These applications, in addition to technology capabilities developed in the text analytics program, were demonstrated for cross-cueing of platforms. A portion of a scenario developed for the WAMI demonstration was expanded for analysis of text for content understanding and event prediction. These analytics provide tools that reduce cognitive workload of intelligence analysts seeking knowledge in very large document sets. Sample technologies included summarization, social network extraction, and foreign language exploitation of relations in networks, discourse and sentiment analysis, and predictions of regional conflict. Cross-cueing events included areas suggested for WAMI watch-boxes, potential individual/groups for monitoring, and contextual understanding behind observed WAMI activities.

7.2 Strategic Analysis Enterprises, Inc.

Topic: Forecasting Conflict & Estimating Effects of Courses of Action Using Near-Real Time Social Media and Group-Level Discourse Data and Models

JIFX Area of Focus: Intelligence, Surveillance, and Reconnaissance (ISR)

Summary: Strategic Analysis Enterprises, Inc. (SAE), extracted sentiment, emotions, events, and discourse markers from near real-time social media and news feeds. SAE displayed the trends over time and space and used the data in forecasting models to forecast destabilizing events across time and space. SAE then analyzed different potential courses of action using matched observation and counterfactual analysis to mitigate the occurrence of destabilizing events and assess likely impacts. The specific scenario focused on a port visit to Lagos, Nigeria, and the likely environment a commander would encounter upon arrival. SAE provided 6-month forecasts of hotspots in other regions of Nigeria focused on Boko Haram, an Islamic insurgent organization, and its likely violent activities across various regions of Nigeria. SAE mined social media, news feeds, and Boko Haram YouTube videos and created quantitative indicators of societal fear and anger toward the government and Boko Haram. They also analyzed the group's messages in terms of cognitive complexity and idea density. Using these data, SAE forecasted likely trajectories

of violent events across Nigeria 6 months into the future. In addition to the NPS JIFX demonstration, the SAE tools and techniques have been successfully applied to a STRATCOM program of record. SAE is also working with AFRL to transition this technology to the National Air and Space Intelligence Center for operational use. The SAE forecasts are used by the Central Intelligence Agency, Department of State, and many combatant commands through the Lockheed-Martin Worldwide Integrated Crisis Early Warning System, in which SAE analytics is a critical component.

7.3 Charles River Analytics, Inc.

Topic: Collaborative Narratives for Social Media Information Fusion

JIFX Area of Focus: Intelligence, Surveillance, and Reconnaissance (ISR)

Summary: The wealth of data provided by modern social media information fusion tools exceeds the ability of intelligence analysts to effectively process, exploit, and disseminate actionable intelligence. This issue arises because these information fusion tools define information value and usage statically, and consider analysts solely as resource-unbounded, deterministic reasoning mechanisms, rather than dynamic, critically thinking individuals who may exhibit biases and cognitive overload. To overcome those issues, Charles River Analytics, Inc. (CRA), developed a system for using Knowledge of Narratives for Optimizing Workspaces to Enhance Reasoning (KNOWER). KNOWER provides a revolutionary approach to information fusion that uses narratives to enable analytical capabilities that support analysts in exploiting modern data collection capabilities. Narratives are a natural and prevalent form of communication used to relate, summarize, and emphasize information to make sense of the world. Narratives provide temporal, spatial, and intentional information about characters and their actions in an easily understandable format. KNOWER harnesses existing and novel fusion techniques with respect to framing concepts in terms of narratives in supporting the intelligence analyst's investigative process. Additionally, KNOWER integrates the CRA Collaborative Visual Exploitation and Reasoning Tool to provide semantically rich, chat-based collaboration mechanisms that supports higher-level information sharing of concepts, entities, relationships, narratives, and products. The transition plan for the KNOWER software is the Army's Distributed Common Ground Station for Special Operations Forces' use.

7.4 Knowledge Based Systems, Inc.

Topic: Text Analytics Situational Awareness Toolkit (T-SAT)

JIFX Area of Focus: Intelligence, Surveillance, and Reconnaissance (ISR)

Summary: T-SAT provides a comprehensive text analytics-based enabling capability for improved threat detection, contextual understanding, event prediction, and decision making. T-SAT uses ontology-driven text processing methods to extract information and knowledge from large amounts of multisource text data to recognize complex relationships contained within the information and presents the results in a concise and easy-to-comprehend way. By semantically tagging the ingested data, T-SAT organizes and manages information to enable rapid and more meaningful responses to queries and customizable report generation. Originally designed for the intelligence community, the use of T-SAT in this experiment demonstrated the ability to analyze different types of data such as news articles, blogs, Twitter, and simulated intelligence message feeds. T-SAT provided directed insight into coordinated activity and relationships among people, organizations, and locations (social and geospatial networks) as well as perceived threat events or behaviors (event networks). With the ability to recognize complex events and social networks, the T-SAT application provides a critical enabling capability to address the dynamically changing demands of intelligence vigilance.

7.5 Ben-Gurion University of the Negev

Topic: Enhanced Document Summarization

JIFX Area of Focus: Intelligence, Surveillance, and Reconnaissance (ISR)

Summary: MUSEEC (MUltilingual SEntence Extraction and Compression) application is a part of a program aimed at identifying the salient parts of a single text document or a collection of topic-related text documents in multiple languages and presenting the extracted text summary to the user in a human-readable and coherent form. MUSEEC provided automatically generated summaries for the documents provided in JIFX 15-2 data with the named entities (NEs) recognized and marked. The summaries and their geo-tagging information (NEs representing locations) were used by a WAMI engine to relate described events to a particular geo-location. The MUSEEC user interface allows the size of the produced summaries to be controlled in terms of the number of characters, words, and sentences or a fraction of the original document.

7.6 Intelligent Automation, Inc.

Topic: Search, Analyze, and Visualize Social Media

JIFX Area of Focus: Intelligence, Surveillance, and Reconnaissance (ISR)

Summary: Intelligent Automation, Inc. (IAI), collected real-time social media data (e.g., Twitter) and provided the capability to search, analyze and visualize large collections of Twitter data via text and graph analytics using IAI's cloud-based software Scraawl. In particular, IAI presented 1) basic statistics of these data (e.g., top users, hashtags, mentions, and URLs), 2) advanced analytics (e.g., community detection, influential users, sentiment analysis, and topic modeling), 3) visualization (e.g., timelines, heat maps, influence network maps, and community clustering), and 4) advanced search (e.g., keyword search, time and location filtering, and exclusion and inclusion of searches). The output was an intelligence report summarizing the key actors, influencers, communities, organizations, and the relationships among the aforementioned entities and events of interest.

7.7 Air Force Research Laboratory/RYA (Layered Sensing Exploitation Division)

Topic: Multi-Source Data Analytics using Wide Area Motion Imagery (WAMI)

JIFX Area of Focus: Intelligence, Surveillance, and Reconnaissance (ISR)

Summary: Advances in WAMI technology applications were recently demonstrated in Trident Spectre 14 including near real-time forensic vehicle and dismount detection and tracking, activity (stops, starts, turns, aimless driving, etc.) detection, and heat maps of tracks and activities. These applications, in addition to technology capabilities developed in the text analytics program (e.g., document summarization, social network extraction, foreign language exploitation of relations in networks, discourse and sentiment analysis, and predictions of regional conflict), were demonstrated for cross-cueing of platforms. Cross-cueing events included areas suggested for WAMI watch-boxes, potential individual/groups for monitoring, and contextual understanding behind observed WAMI activities.

7.8 Applied Communication Sciences, Inc.

Topic: Dynamic Event Extraction and Prediction (DEEP)

JIFX Area of Focus: Intelligence, Surveillance, and Reconnaissance (ISR)

Summary: The goal of the program was to develop technologies that enable intelligence analysts to rapidly extract information about events, entities, and relations from large volumes of text using cutting-edge information extraction technologies. This enabled analysts to rapidly focus on the current interest of terrorists and their use of code words to "hide" information. It also enabled the analyst to identify persons and events that are related to each other.

7.9 Kitware, Inc.

Topic: Waterfall

JIFX Area of Focus: Intelligence, Surveillance, and Reconnaissance (ISR)

Summary: WATERFALL is a software services solution that leverages a combination of commercial off-the-shelf (Knowmadics CASES and SilverEye) and government off-the-shelf (GOTS) (ISRFabric) software applications to enable the tactical operator to purchase a 4G handset on the local economy and begin using it as a location-based collection asset with minimal user configuration. For this experiment, the tactical operators connected their 4G smartphone to TrustComm's Ka/4G/LTE comms backbone provided for the event. The data was transported via the ISRFabric (GOTS) for display to operators working across network domains.

7.10 University of Washington

Topic: Accurate, Intuitive, Scalable Text Analytics

JIFX Area of Focus: Intelligence, Surveillance, and Reconnaissance (ISR)

Summary: University of Washington's (UW's) research focused on 2 key threads: 1) joint entity linking and information extraction, and 2) large-scale multidocument summarization.

1) Joint entity linking and information extraction. Motivated by the need for corpus-level analysis of text, there has been an increasing interest in modeling global entities and relations that appear in the text across multiple documents and aligning them to external knowledge bases such as Freebase. Current systems target entity linking, cross-document coreference, and relation extraction as separate tasks, resulting in little or no exchange of

information across these problems. However, these tasks are inherently dependent on each other, and models of text that capture these dependencies can result in accurate extraction of facts from large text corpuses. UW focused on joint modeling of this process toward the goal of achieving significant gains in the quality of information extraction.

2) Large-scale multidocument summarization. The explosion in the number of documents currently available over the Web necessitates automated approaches that organize and summarize large document collections on a complex topic. Existing methods for multidocument summarization condense 10–15 documents into a short flat summary; they are insufficient for large-scale summarization. For large-scale summarization, summarizers are needed that organize the information coherently and enable personalized interaction with the summary so that users can explore the various aspects of information in different levels of detail based on individual interest. UW focused on implementing such a system under a novel paradigm, Hierarchical Summarization.

7.11 Raytheon BBN Technologies, Inc.

Topic: Automatic Analytics for Non-English Text with Bilingual Tools

JIFX Area of Focus: Analytics of Non-English Text

Summary: Information extraction technologies transform free form prose (e.g., news articles, eyewitness reports, and tweets) into normalized information that can be integrated into automatic analytics (e.g., structured summaries, visualizations of social networks, geo-location, and forecasting models). This can be done successfully for English text; however, traditional approaches have not performed accurately on non-English sources. In a disaster relief situation outside of the United States, it is likely that news, social media, and other critical sources of situational awareness are likely to appear in the local language. While tools exist to automatically translate non-English text, the output of even the best automatic translations frequently contains errors that hinder the accuracy of a pipeline to 1) translate text; 2 apply information extraction tools. Machine translations' tendency to make errors on names (e.g., not translating Boko Haram or ISIS) is a particular challenge for the pipelined approach to information extraction from non-English.

BBN has designed a capability that operates over the source language text in conjunction with automatic translation to improve the accuracy of automatic extraction. As a proof of concept, BBN developed relation extraction tools to extract relations (i.e., "person-Is-Acquainted-With-Person," "person-Is-Member-

Of-Organization", "person-Visited-Location", and "person-Made-Statement-On-Topic"). These extractors were applied to non-English documents (in BBN's prototype Chinese) and the output of the extractors was used to produce concise structured summaries. The tool is designed to require minimal manual input to automate the relation extraction process for a new relation in a new language. BBN achieved this goal by allowing initialization of a new extractor using either non-English or English examples and by leveraging as much as they could from the machine translation while using the access to the source text to account for translation errors.

8. Conclusion

Advanced text analytics capabilities were demonstrated in a logically coherent workflow pipeline that supported the military OODA loop and allowed cross-cueing of a WAMI sensor. The aggregated findings of these text processing capabilities allowed the targeted use of the WAMI sensor (albeit in a notional sense) for rapid detection of mission-critical events. The creation of a very large text database from open source data provides a relevant and unclassified foundation for continued development of text processing capabilities. The ground truth features of the data set provide a valuable contribution to the test and evaluation of emerging technologies.

Future science and technology goals for this domain include closer applications of text-based knowledge and WAMI views. A near-term exploration is to develop overlays of local context for a geographic region, obtained from text analytics, for near or real-time imagery. Similar to how weather patterns are tracked on a map for local weather forecasts, violence trends, social media topic trends, and sentiment trends can be overlaid on a geographic map to enhance contextual understanding of imagery features.

The NPS JIFX demonstration venue has been shown to be valuable for emerging technologies at mid-range technology readiness levels. The access to Combatant Command science and technology officers supports communication between scientists and military advisors, which serves to enhance the military relevance of new capabilities developed by university and industry technologists not familiar with military tactics, techniques, and procedures.

9. References

1. Boyd JR. The essence of winning and losing. Unpublished briefing slides; 1996 Jan.

1 (PDF) DEFENSE TECHNICAL INFORMATION CTR DTIC OCA

2 (PDF) DIRECTOR US ARMY RESEARCH LAB RDRL CIO LL IMAL HRA MAIL & RECORDS MGMT

1 (PDF) GOVT PRINTG OFC A MALHOTRA

1 (PDF) APPLIED COMMUNICATIONS SCIENCES J DESMARAIS

1 (PDF) BEN GURION UNIVERSITY M LAST

1 (PDF) INTELLIGENT AUTOMATION, INC. O SAVAS

1 (PDF) KNOWLEDGE BASED SYSTEMS, INC. P BENJAMIN

1 (PDF) RAYTHEON BBN M FREEDMAN

1 (PDF) STRATEGIC ANALYSIS ENTERPRISES (SAE), INC. S SHELLMAN

1 (PDF) UNIVERSITY OF WASHINGTON S SINGH

1 (PDF) CHARLES RIVER ANALYTICS A GEE

1 (PDF) AFRL S THOMAS

1 (PDF) KITWARE M TUREK

1 (PDF) ZIMMERMAN CONSULTING GROUP, LLC R ZIMMERMAN

1 (PDF) DIRECTOR US ARMY RESEARCH LAB RDRL CII T E BOWMAN